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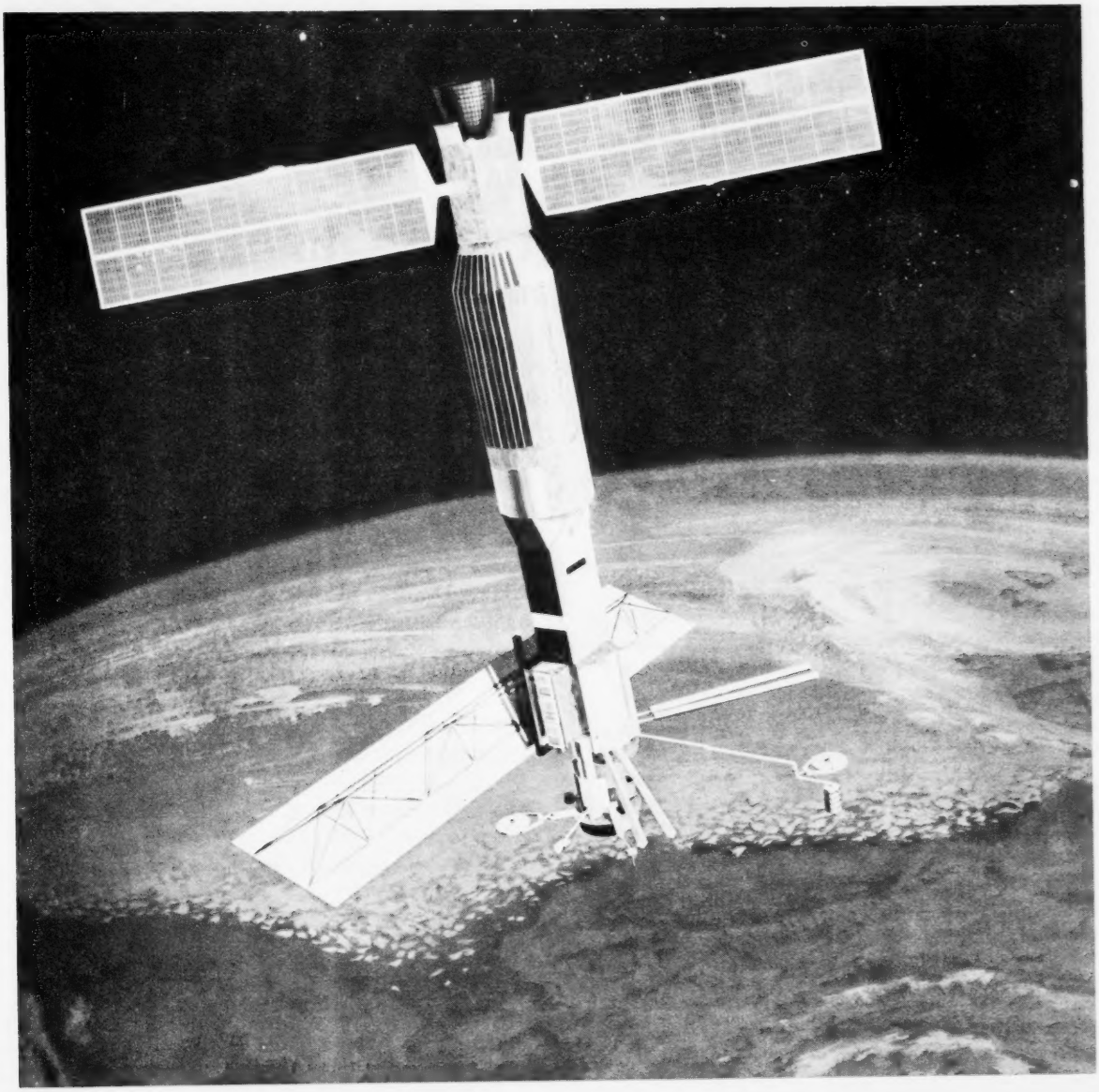

Cover

Looking Down from Seasat—Painting shows how the new satellite will study the world oceans from Earth orbit. Seasat imagery will help land-based scientists determine whether microwave sensors are of value in providing information about sea-state and related weather phenomena. The spacecraft is managed by NASA's Jet Propulsion Laboratory. From an altitude of 800 kilometers, Seasat will circle the globe 14 times a day, providing coverage of 95 percent of the oceans every 36 hours. The instrument resolution varies, but can measure areas as small as 25 meters.

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Letter from Washington

Dear Colleagues:

Last April, my letter from Washington emphasized the long-term value of NASA programs that seek raw knowledge or the answers to crucial scientific questions, as well as our more visible programs with directly identifiable near-term benefits. I mentioned then and I repeat now the importance of communicating a full understanding of the value of our work in space to our fellow citizens.

This month, of course, is of special significance to us and to the nation because it marks the anniversary of the epic voyage of Apollo 11. It is a most appropriate time to highlight our activities in space and to increase public understanding of their value.

It is exciting to consider what is happening in space during this anniversary period.

- After making the first close-up observations of Jupiter, Pioneer 10 is enroute out of our solar system, the first human product to leave our home corner of the galaxy. Its sister craft, Pioneer 11, is approaching Saturn to give us our first close look at the interesting planet.
- The two Voyagers are well on their way to make follow-up measurements of Jupiter and Saturn and their satellites, with a visit to Uranus planned if all goes well.
- The highly successful Viking orbiters and landers are continuing to send valuable scientific data back from Mars.
- The first element of a Pioneer mission to Venus is on its way and will swing into Venusian orbit early in December, with a second element to follow next month to probe the planet's hot and heavy atmosphere five days after the arrival of the orbiter.
- Two specially instrumented International Sun-Earth Explorers are in orbit investigating the dynamics and stability of the Earth's bow shock and magnetopause, to be joined next month by a third member of that scientific spacecraft team.
- An International Ultra-violet Explorer launched last January is giving us new data on the nature of the different kinds of stars in our galaxy, on the inter-stellar material from which stars are formed, and on many of the objects which are emitting radio waves and X-rays.
- The first High Energy Astronomical Observatory, the heaviest Earth-orbiting satellite ever launched, has completed a six-month X-ray survey of the universe, is busy investigating specific X-ray and gamma ray sources and is looking for "black holes."
- The third Landsat, with its added and improved sensors, is returning even better data on Earth resources and phenomena than its very successful predecessors.
- At this writing, Landsat C was shortly to be joined in its remote sensing mission by Seasat A with its unique capability to measure surface winds and temperatures; currents; wave heights, spacing and direction; ice conditions and ocean topography.
- Landsat and Seasat remote sensing capabilities are being supplemented significantly by data from the Heat Capacity Mapping satellite launched last April.
- Advanced, high power communications satellites are providing a variety of important public services in the field of health, education and emergency communications, and
- Other satellites are giving people around the world cheaper, more efficient long-distance communications, inter-continental real-time television and frequent, routine global weather maps most of us have long taken for granted.

The foregoing examples represent only a few of our current operations in space, and the future is even more promising.

The key to the future in space is the Shuttle: its easy, routine, much less expensive access to space;

its capability to service, return or replace satellites in near-Earth orbit; the freedom it will provide from previous weight and volume constraints, demands for redundancy, extraordinarily rigorous testing and conservative failure margins; and its eventual ability to serve as a construction station for a variety of large structures in space.

The Space Telescope, which astronomers have been planning since the early sixties, will become a reality in the mid-eighties, thanks to the ability of the Shuttle to revisit for orbital maintenance. The contributions of the Space Telescope to our understanding of the physics of the universe are likely to dwarf all but the most fundamental discoveries of the past and lead to a quantum growth in our knowledge of the basic nature of time, matter and energy.

Follow-on High Energy Astronomy Observatories will complement the Space Telescope with surveys and studies of the nature, sources intensities and behavior of X-rays, gamma rays and cosmic rays.

Flying in the Shuttle and possibly later in free flight, the European Space Agency's versatile Spacelab will steadily broaden our data base in the fields of Earth observation, materials science, communication and navigation, space and atmospheric physics and life sciences.

Late in 1981 or early in 1982, the Shuttle will launch the Galileo spacecraft for a detailed scientific investigation of Jupiter and its satellites, including direct measurements of the planet's atmosphere.

Later in the decade of the eighties, development of ion drive propulsion will greatly expand our capabilities for planetary exploration and offer the interesting prospect of a rendezvous with the Comet Encke in 1987.

The Solar Maximum Mission, the Solar-Polar flight and the Solar Mesopheric Explorer will give us valuable new knowledge of solar phenomena, their interaction with the terrestrial environment and their effect on the weather and climate of Earth.

In the area of remote sensing, Magsat, the Radiation Budget Satellite, follow-on Landsats and possibly Seasats will similarly increase our understanding of the characteristics of our own planet and we will learn to integrate those and many other remote measurement and data acquisition systems into a continuous, accurate world information network for the wiser management of planetary resources and and human affairs.

The ability of the Shuttle to put up satellites with higher power, higher data rates, better frequency manipulation, and "switchboard" capabilities will lead to a "second communications revolution" and an era of communications services that can change society for the better. Concepts of public service telecommunications like electronic mail, medical information service delivery and continuing interactive education will be available to us if we want them.

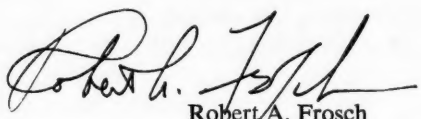
New orbital construction techniques made feasible by the Shuttle hold the potential of making the distant possibility of beamed solar power a reality.

Finally there exists in the foreseeable future the very real, although unquantifiable possibility of contact with other intelligent beings in the universe. Such contact would transform our lives. Continued failure to make such a contact, on the other hand, would tend to indicate the temporary nature of advanced civilizations and provide the basis for some serious reflections on the character of our own.

Considering the level of our present activity, and the prospects and promise of space for the expansion of human knowledge and the improvement of the human condition, a degree of healthy enthusiasm and advocacy is inevitable in those of use who are involved.

It is my hope that during this Apollo anniversary period we can infuse the maximum number of our fellow citizens with that same enthusiasm.

Sincerely,



Robert A. Frosch

Doctorate Awarded Wallops Center Director

Robert L. Krieger, director of NASA's Wallops Flight Center, received an honorary Doctorate of Engineering at commencement ceremonies held at the University of Maryland Eastern Shore in Princess Ann, Md. May 21, 1978.

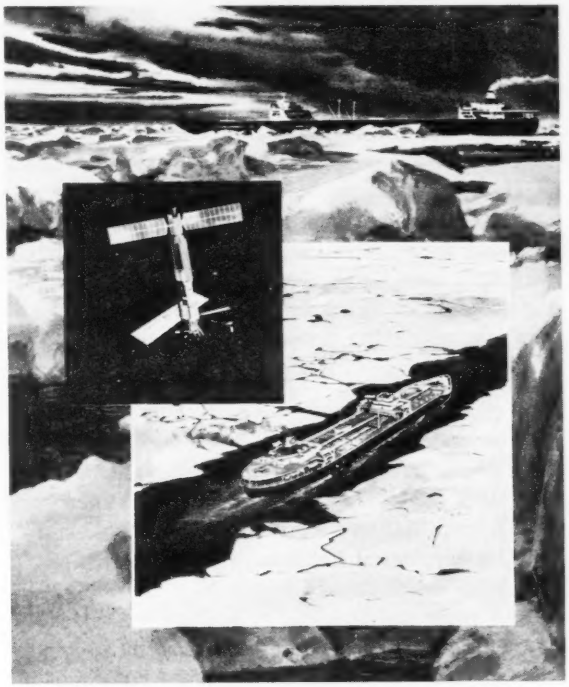
Krieger began his career with NASA's predecessor, NACA, and continued thereafter to devote his talent to the expansion of knowledge and technology in the fields of aeronautics and space. He has made outstanding contributions to the development of instrumentation technology, rocket launch facilities and techniques, application of space technology to Earth studies, and to the development of programs of international cooperation in space efforts.

In a letter to the university acknowledging his award, Dr. Krieger said: ". . . I am kept humble only by the sure knowledge that any honor I receive is mostly because I have always had a number of very good people working hard to make me look good!"

He added, in a separate memorandum to the Wallops staff: "Since I've only really had one job in my whole life, and you are the only group of people I have ever had the privilege of directing, I am fully aware that the great work of the Wallops team is what got me the award—and I am truly grateful to you for it."

Satellite to Study the World Oceans

NASA launched Seasat-A, the first satellite to study the world's oceans, from the Western Test Range, Vandenberg Air Force Base, Lompoc, Calif., June 26, 1978. Seasat-A, a "proof-of-concept" mission, will be used to determine if microwave instruments scanning the oceans from space can provide useful scientific data for oceanographers, meteorologists and commercial users of the seas. The spacecraft will send back information on surface winds and temperatures, currents, wave heights, ice conditions, ocean topography and coastal storm activity.



Spacewatcher—How the recently launched Seasat spacecraft will help locate sea ice and sea leads (navigable openings in ice), in an effort to provide safe passage for ships at sea. Seasat will return volumes of data to Earth in its continuous scanning of the world oceans.

An Atlas-Agena launch vehicle sent Seasat-A into a near circular polar orbit 800 kilometers high. The spacecraft will circle the Earth 14 times a day and its instruments will sweep across 95 percent of the oceanic surfaces every 36 hours, providing oceanographers with their first synoptic, or world-wide, observation of the oceans. The spacecraft has all-weather capability, and can see as well at night as in the daytime.

Seasat-A will be used to prove the feasibility of later employing an operational, multiple-satellite Seasat network to monitor the world's oceans on a continuous, near-real-time basis. Twice daily, such a system could provide ships at sea with detailed charts of routes that could be updated to show latest weather conditions, sea state and hazards. Long-range use of the system could influence ship design, port development and selection of sites for such off-shore facilities as power plants. Commercial fishermen, oil exploration firms, the Weather Service, pollution control agencies, the Coast Guard and Navy, and a variety of others could become users of Seasat data.

The basic part of Seasat-A (engineers call it "the bus") is an Agena that serves as second stage of the launch vehicle and carries a sensor module on which the instruments and related science payload are mounted. Agena is a three-axis-stabilized spacecraft that has flown more than 300 missions.

The instrument payload includes four microwave sensors and a visual and infrared radiometer. Experiment teams, drawn from scientists representing various oceanographic disciplines, will determine the geophysical significance of the microwave data. The four microwave instruments are:

- A scanning multifrequency microwave radiometer used to measure sea-surface temperature, estimate wind speed and detect water in the atmosphere (either vapor or liquid). Duncan Ross of the National Oceanic and Atmospheric Administration's Atlantic Oceanographic and Meteorological Laboratory in Miami, Fla., is team leader.
- A radar scatterometer to measure sea-surface effects that can be converted directly to wind speed and direction. Prof. Willard Pierson of the State University of New York is team leader.
- A synthetic aperture radar to provide all-weather high-resolution pictures of ocean waves, ice fields, icebergs, ice leads (linear openings in ice through which ships may navigate) and coastal conditions. (The radar also can return imagery of conditions on land.) The instrument will be used only when Seasat-A can "see" one of the tracking stations specially equipped to handle its large amounts of data. Dr. Paul Teleki of the U.S. Geological Survey, Reston, Va., is team leader.
- A radar altimeter serving two functions—monitoring average wave height and "significant wave height" (a term oceanographers use to designate the largest one-third of all waves), and the altitude of the spacecraft above the ocean to a precision of 10 centimeters. The altimeter will let scientists measure sea surface topographic features that relate to ocean tides, storm surges and currents. Dr. Byron Tapley of the University of Texas is team leader.

A fifth instrument aboard Seasat-A—a visual and infrared radiometer—will provide data to support information from the microwave sensors. It will measure sea surface temperature in clear weather, and take pictures of cloud patterns and ocean and coastal features. Team leader is Dr. Paul McClain of the National Oceanic and Atmospheric Administration's National Environmental Satellite Service, Camp Springs, Md.

For the first month or more after launch, scientists and engineers will calibrate instruments and check out and improve computer programs that have been designed to translate Seasat data into useful information. After the calibration phase is complete, the observation period will begin.

While Seasat-A takes its measurement from space, an extensive program of "surface truth" also will be under way. Low flying aircraft, ships and instrumented buoys will take measurements to corroborate Seasat data.

Although Seasat-A's primary mission is for one year, sufficient fuel and other consumables are being put aboard so the flight can be extended for another two years.

The Seasat-A program is managed for NASA by the Office of Space and Terrestrial Applications. NASA's Jet Propulsion Laboratory manages the project and the satellite system. NASA's Goddard Space Flight Center, provides tracking, orbit and attitude determination for the mission and the project operations control center. NASA's Lewis Research Center has management responsibility for the launch vehicle. The launch crew is provided by the U.S. Air Force Space and Missile Test Center. Lockheed Missiles & Space Co., Sunnyvale, Calif., is prime contractor for the satellite system.

First Spacelab Science Team Selected

Two Americans have been named by NASA as part of an international group of five scientists who will serve as payload specialists during the first Spacelab mission scheduled for the latter part of 1980.

The American payload specialists were nominated and selected by the Investigators Working Group (IWG), which is composed of scientists representing all investigators.

The selectees are:

- Dr. Michael L. Lampton, 37, of Berkeley, Calif., a space physicist at the University of California, Berkeley; and
- Byron K. Lichtenberg, 30, of Natick, Mass., a vestibular researcher at the Massachusetts Institute of Technology, Cambridge, Mass.

One American and one European eventually will be selected to fly aboard the Earth-orbiting space laboratory and operate the science instruments.

Payload specialists are new to the space program. Their responsibilities will be to perform experiments in space aboard NASA's Space Shuttle, which will carry the European- built Spacelab into Earth orbit. Payload specialists are not pilots, and are not to be confused with mission specialists. The latter are crew members responsible for *all* aspects of the Shuttle flight except piloting.

The three payload scientists who are not chosen to fly in space will act as backup specialists, participating in ground-based mission activities at NASA's Johnson Space Center during the flight. That choice will be made some months before the flight.

The American payload specialists named this week were selected from a list of six finalists. The European scientists, announced last week, were selected by the European Space Agency (ESA) from among thousands of applicants in its member states after parallel screening programs were conducted in Europe.

The three payload specialists selected by ESA are:

- Ulf Merbold, 36, German, a scientist at Max Planck Institute, Stuttgart, West Germany;
- Claude Nicollier, 33, Swiss, a scientist and pilot at the European Space Technology Center (ESTEC), Noordwijk, Netherlands; and
- Wubbo Ockels, 31, Dutch, a physicist at Groenigen University, Netherlands.

The first Spacelab will be launched aboard the Shuttle from NASA's Kennedy Space Center in Florida. It will orbit the Earth at an altitude of 250 kilometers (155 miles). At the end of the seven-day mission, the Shuttle will return for a runway-type landing at the Kennedy Center, be serviced and readied for other missions.

NASA's Marshall Space Flight Center is responsible for the payload specialists' training activities as part of its overall management responsibility for the Spacelab mission. ESA's Spacelab Payload and Coordination organization in Europe will manage training activities in Europe.

Skylab Maneuvers

NASA has successfully maneuvered the orbiting Skylab space station into a low drag attitude that is expected to add months to its lifetime in space.

The activities, completed June 10, involve putting a new computer program into the onboard computer, using the attitude control system to maneuver Skylab into the desired position and operating the control moment gyros to keep the spacecraft in that mode. These procedures were completed in mid-June.

These measures are designed to establish control of the spacecraft and thereby extend its orbital lifetime by perhaps as much as 6 to 12 months. If the gyros continue to operate to hold Skylab in its new attitude, reentry into the Earth's atmosphere could be delayed until sometime between late 1979 and mid-1980. The maneuvers will decrease atmospheric drag on the spacecraft by orienting it to be aligned with the flight path.

Skylab will be monitored on a daily basis. NASA program managers hope no additional maneuvers or adjustments will be necessary. A successful attitude change maneuver could provide sufficient time to carry out a Skylab reboost or controlled deorbit mission on an early Space Shuttle flight.

Vital Weather Satellite Launched

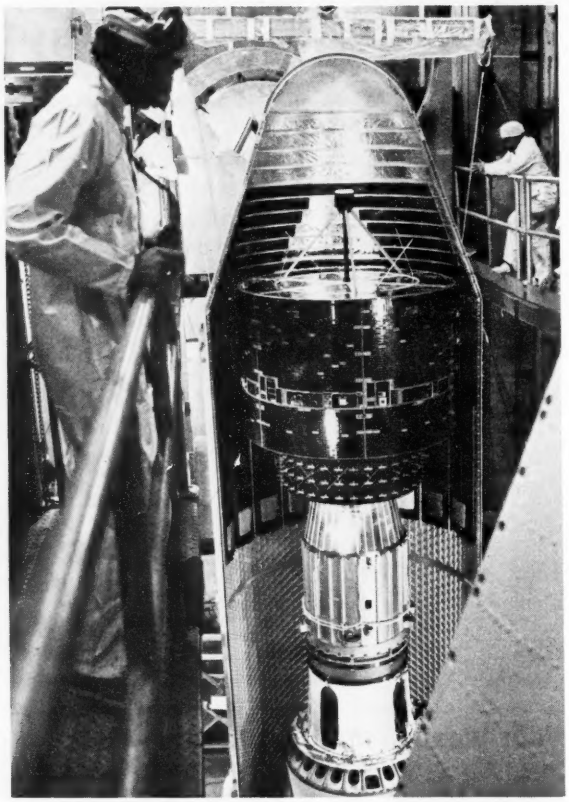
A carefully controlled series of space maneuvers began in June with the launch of a National Oceanic and Atmospheric Administration satellite by NASA. It will end next winter with the start of an international study of global weather.

The successful launch from NASA's Kennedy Space Center in June of the Commerce Department agency's GOES-3 geostationary satellite is a key element in the Global Weather Experiment, a world-

wide, year-long accumulation of meteorological and oceanographic data which begins in December 1978.

The largest international scientific project in history, with 140 nations participating, the experiment depends upon information collected from many sources. Oceanographic and wind observations all over the world will be made by nine satellites and scores of ships and aircraft, while thousands of surface and upper air observations will be made daily by several hundred buoys distributed in the southern hemisphere and by conventional observation methods elsewhere on Earth.

The experiment is a part of the Global Atmospheric Research Program, sponsored by the World Meteorological Organization of the United Nations and the International Council of Scientific Unions. It will be conducted throughout 1979, providing scientists with millions of pieces of information from all over the world.



Another Weather Watcher—NOAA's Geostationary Operational Environmental Satellite as it was encapsulated inside its payload fairing aboard a Delta rocket at the Kennedy center. GOES-3, launched by NASA June 16, is the third such satellite to provide round-the-clock coverage of the natural forces that create global weather.

The GOES-3 spacecraft will play a major role not only in providing Western Hemisphere coverage for the experiment, but the success or failure of the mission will determine how much important meteorological information will be available from a data-sparse area of the world centered in the Indian Ocean.

GOES-3 is in orbit at 35,750 kilometers. It replaces another NOAA geostationary satellite now positioned to observe much of the Pacific Ocean and the western half of the United States. That spacecraft—GOES-1—will be moved by stages from its present position above the equator at 135 degrees West longitude, almost halfway around the Earth to about 60 degrees East longitude.

GOES-1 first will be shifted to 15 degrees west, over the Atlantic Ocean, where it will remain under the control of NOAA's National Environmental Satellite Service Command and Data Acquisition Station in Wallops, Va. At the same time, space technologists at a new acquisition station being installed in Spain by the European Space Agency will participate in control of the spacecraft for familiarization purposes.

About the first of November, GOES-1 will be in position over the Indian Ocean, fully under control of the Spanish station and ready to begin providing information on Dec. 1 for the Global Weather Experiment. In that experiment, five geostationary and four polar-orbiting spacecraft will be collecting data: GOES-1 and GOES-2 above the equator over South America, and GOES-3; a European satellite in position above the equator over Western Africa; and, a Japanese spacecraft over New Guinea. Two of the polar-orbiting spacecraft will be NOAA satellites—Tiros-N to be launched in July, and NOAA-6 scheduled for October launch; and two will be operated by the USSR.

The GOES-3 satellite is almost identical to four earlier geostationary environmental monitoring satellites launched by the United States since 1974. Like its predecessors, it will provide a variety of imagery of North and South America and much of the Atlantic and Pacific Oceans every half hour. The imagery is used by meteorologists in weather forecasting, wind and cloud cover analyses, severe storm warning and hurricane tracking, and other activities. Oceanographers use information from the spacecraft for ocean

current analysis, ship routing, location of ocean upwelling, ice evaluation, and other purposes; and hydrologists find the information valuable for snow melt and snow area determination, water resource management, and various agricultural aplications.

In addition, the GOES series of spacecraft collects and transmit information recorded by data collection platforms at remote places on land, on buoys in the ocean, and carried aloft by balloons and aircraft. This information is communicated by the GOES satellites to users on earth. The spacecraft also measure solar activity, detect solar flares, and determine the intensity of solar winds and the strength and direction of the Earth's magnetic field.

GOES-3 was boosted into orbit by a three-stage Delta launch vehicle and in its initial stages was controlled by NASA's Goddard Space Flight Center.

GOES-3 is expected to be the last NOAA geostationary satellite to be launched by NASA atop a rocket. Three more geostationary spacecraft are planned during the next eight years, to be carried into space on NASA's Space Shuttle, beginning with GOES-D, now expected to be placed in orbit in late 1980.

Frosch Is Guest of Honor at National Reception—The National Association of Labor Editors chose NASA Administrator Dr. Robert A. Frosch as a featured speaker at its recent annual conference held in Washington, D.C. Frosch spoke to the 200 attendees of the reception about the potential of the Space Shuttle. Here Frosh stands between Robert E. King (left), NASA director of the office of industrial relations and Robert J. Kalaski, director of public relations at the International Association of Machinists and editor of the association's *The Machinist*. Visible behind the three men is an ice carving of the Shuttle, which was the centerpiece on the buffet table.

HCMM Satellite Takes Earth's Temperature

The first spacecraft built to test the feasibility of measuring variations in the Earth's temperature was launched by NASA at the Western Test Range, Vandenberg Air Force Base, aboard a Scout launch vehicle in April, 1978.

Called the Heat Capacity Mapping Mission (HCMM), the experimental satellite travels in a circular, sun-synchronous 620-kilometer orbit that allows for measuring mid-latitude test areas of the Earth's surface for their minimum temperatures and then measuring maximum temperatures about 11 hours later in the same areas.

A two-channel scanning radiometer will acquire images in the visible and near infrared spectrum during the day and in the thermal infrared spectrum both day and night.

HCMM is the first in a series of relatively low-cost (about $5 million), modular-design spacecraft built for the Applications Explorer Missions (AEM)—small experimental spacecraft in special orbits to satisfy mission-unique experimental data acquisition requirements. The present mission was designed to allow scientists to determine the feasibility of using day-night thermal infrared remote sensor-derived data for various purposes.

HCMM data will be correlated with those received from other satellites, especially from Landsat, the Earth resources spacecraft, and with ground observations, to provide a better insight into detecting time-temperature variations of the Earth's surface.

The spacecraft is unique in that its day-night heat measurement sequence permits readings of temperature changes associated with solar heating during the daytime and radiative cooling at night. Some types of rocks such as shale have a wide day-night temperature difference, and other types such as quartz have a narrower one.

Test sites for HCMM measurements are located in various parts of the continental United States, Western Europe and Australia. Twelve American and 12 foreign investigators are participating in the program.

Some of the planned experiments are to:

- Discriminate among rock types and identify such features as subsurface faults or fractures not seen in the visible spectrum. For instance, some types of rock formations may emit similar radiation characteristics in the visible spectrum because of weathering erosion, or silt cover, whereas the thermal spectral band, by measuring temperature

differences, may indicate structural and compositional differences.

- Survey soil moisture of cultivated areas including some with extensive irrigation. For example, wet soils have a very low temperature variation during the day-night period, while dry soils and sand reach very high temperatures during the day and become quite cold at night.
- Determine whether plants are "running temperatures" by observing the changes in temperature readings of the vegetated areas. When a plant has adequate water, its use of that water—transpiration—keeps it cooler than the surrounding air. A dehydrated plant exhibits a higher temperature, thus indicating plant stress.
- Map flood runoff and thermal effluents into coastal zones and the Great Lakes by measuring water temperature differences. Such data are expected to improve the monitoring from space of environmental and ecological disturbances to fresh and tidal water resources, i.e., animal, fish and plant life.
- Study "heat islands"—concentrations of heat rising from large metropolitan areas. It is known that the higher temperatures associated with heat from cities can affect their local weather, but it is not known whether these higher temperatures can cause long-lasting changes in regional climate.
- Measure snow fields. Many areas of the country depend on melted snow for their water supplies. Other areas are threatened by floods caused by melting snow. Although snow field areas have been monitored for a number of years by Landsat and other satellites, HCMM should add improved temperature measurements to these snowmelt data and assist scientists in calculating the time and rate of snowmelt.

The satellite is made up of two parts: the instrument, the heat capacity mapping radiometer and its supporting gear; and the spacecraft base module, or bus, containing the necessary data handling, power supply, communications and command and attitude control subsystems to support the instrument module.

NASA's Goddard Space Flight Center is responsible for the design, integration and testing of the satellite and data processing. HCMM data will be collected in real time when the satellite is within line of sight of the following NASA receiving stations—Merritt Island, Fla.; Goldstone, Calif.; Fairbanks, Alaska; Orroral, Australia; Madrid, Spain; and the Goddard Center Engineering Test Center.

The base module was built by Boeing Aerospace Co., Seattle, Wash., and the instrument by International Telephone and Telegraph Co., Ft. Wayne, Ind. NASA's Langley center manages the four-stage, solid fuel rocket that placed the spacecraft in orbit. The Scout launch vehicle is built by Vought Co., Dallas, Texas.

Space Shuttle Main Engine Test Successful

Three Space Shuttle main engines roared to life May 19 in the first major test firing of the Shuttle's main propulsion system. Orange flame and a huge cloud of white steam and smoke poured from beneath the test stand in which the cluster was held firmly to earth during the noisy 15-second run.

That running time was considerably longer than the cluster's only previous firing, a one-second ignition test on April 21. The engines reached 70 percent of their rated power during this test.

Bob Lindstrom, Space Shuttle projects manager at NASA's Marshall Space Flight Center, where the engine is being developed, said after the firing that everything went as planned. "We haven't evaluated all the data," he explained, "but from what we can see, we had a very successful test."

The test firing took place in Bay St. Louis, Miss., at NASA's National Space Technology Laboratories. The test program is managed by the Marshall center and conducted by the Rockwell International Space Division.

During the next several months, additional tests will increase the duration of firing and the engine thrust levels until they are fired at 109 percent of rated thrust for about eight minutes at a time. This will simulate an actual Space Shuttle mission into space.

Solar Power to Provide Electricity for Indian Village

Construction of a totally solar-powered electric system for a village recently was initiated. Representatives of the Papago Tribe of Arizona, the U.S. Public Health Service and NASA's Lewis Research Center announced the signing of a memorandum of understanding to provide the Papago Indian Village of Schuchuli, Ariz., with electric power from the Sun by September 1978. Work began in May.

"This is a first step toward meeting critical power needs for many isolated Indian villages throughout the United States," said Cecil Williams, chairman of the Papago Tribal Council.

Funded by the U.S. Department of Energy (DOE), the Schuchuli photovoltaic village power project is managed by the Lewis Center as part of DOE's National Photovoltaic Conversion Program.

"DOE's program," said Paul Maycock, acting director of photovoltaics, Department of Energy, "is aimed at developing solar cell power systems which can provide a significant amount of the nation's energy requirements by the year 2000. The Schuchuli project is one of several which we hope will stimulate new markets for solar cell power through cooperative cost-shared experiments with potential users."

When completed, the new three-kilowatt solar electric power system will provide Schuchuli's 96 residents with sufficient electricity to power a community refrigerator, freezer, washing machine, sewing machine, water pump and lights for the 16 homes, church and feast house in the village.

At present the Schuchuli people rely on kerosene lamps for lighting. Laundry is washed by hand or taken 32 kilometers to the nearest commercial facility. Perishable foods and medicines cannot be stored. Water for domestic and stock usage is pumped by diesel engine which, because of cost of maintenance and fuel, is a drain on the financial resources of the people. Introduction of solar electric power will change all this.

Present at the signing of the cooperative agreement were Cecil Williams; Dr. E. S. Rabeau, director of the office of research and development of the U.S. Public Health Service in Tucson; and Dr. Louis Rosenblum, chief of the solar and electrochemistry division at the Lewis center.

Dr. Rosenblum noted that the application of solar electric technology in the Arizona desert has worldwide implications. "There are more than three million villages without electrical power in the world today, mainly in the less developed countries," Dr. Rosenblum said. "The success of our experiments at Schuchuli is bound to influence the direction taken by developing countries to satisfy pressing energy needs of their large rural populations."

Under terms of the Schuchuli cooperative agreement, NASA will furnish all materials and technical assistance necessary for installation of equipment and support facilities for the power system.

The Papago Construction Co., an arm of the Papago Tribal Council, will erect the solar arrays and install all power system equipment. Papago workmen also will construct the new domestic services building to contain the new solar powered appliances and an electrical equipment building to house instrumentation, controls and storage batteries. An electrical distribution network, including all wiring exclusive of the actual power system equipment, will be provided by the tribal utility authority.

The Public Health Service will administer local portions of the project, coordinating the connection of mechanical equipment to the power system, installing a septic tank system at the domestic services building and serving as liaison to various federal, regional and state agencies.

Because of potential benefits of solar electric power to people living in places remote from utility power, this project is receiving assistance from other concerned government agencies. The Four Corners Regional Commission has provided a financial grant to the Papago Tribe to defray costs of the domestic services building at Schuchuli. The Bureau of Indian Affairs, Department of Interior, is providing help in expediting contracts.

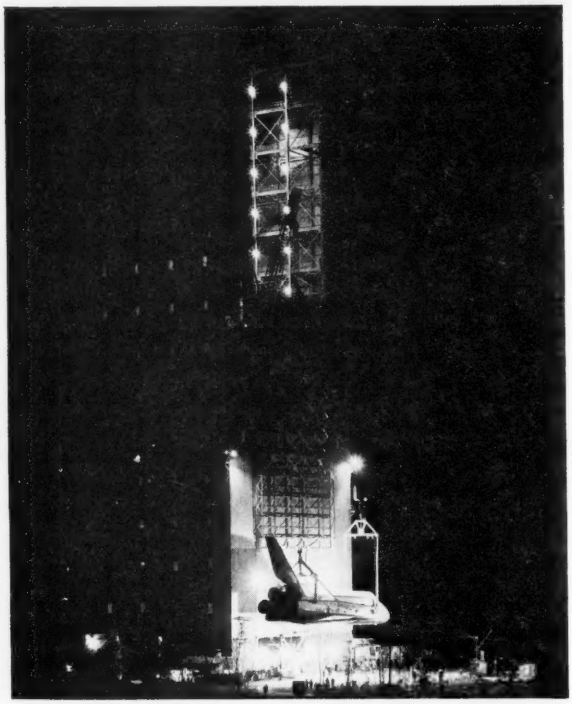
Actors Examine Real-life Spaceship—While in Huntsville, Ala., recently, actor Richard Harris and his actress wife, Ann Turkel, took time out from filming sessions (on a science fiction film) to climb aboard the U.S. Space Shuttle orbiter, *Enterprise*. The vehicle is at NASA's Marshall center for most of 1978, undergoing preflight vibration testing.

Shuttle Vibration Tests Underway

The first phase of the Space Shuttle ground vibration test series began May 30 in a tall test tower at NASA's Marshall Space Flight Center. The tests followed installation in the stand recently of the Space Shuttle's external tank and orbiter *Enterprise* in late April.

The tank and the orbiter were "soft-mounted" inside the stand through use of a system with air bags and cables that suspends the vehicles from a large overhead truss installed like a crossbeam between two test stand walls. It was the first time these two major components of the Shuttle have been mated as they will be for actual flight.

Engineers then installed the system which applies vibrations to the Space Shuttle as it hangs vertically in the test stand. Called the shuttle modal test and analysis system, the computerized system can provide the required vibrational cycles and force inputs as well as acquire the response information from the vehicle.

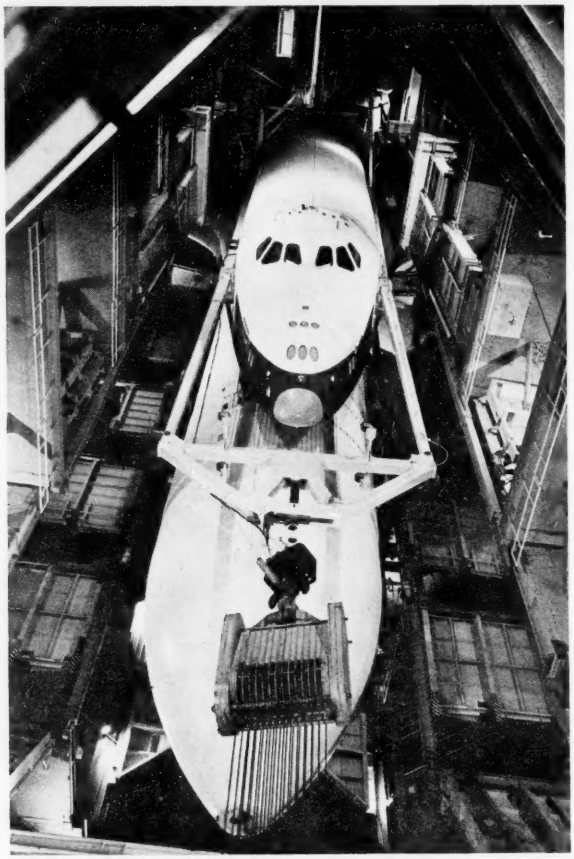


Big Lift—the Space Shuttle Orbiter *Enterprise* is lifted from its ground transporter (which has been removed) and readied for hoisting into the dynamic test stand at the Marshall center. The operation was in preparation for a series of ground vibration tests scheduled to last throughout most of the year.

The term "vibration" could mislead—the system does not shake to learn how strong the vehicle is. Instead engineers apply vibrations to the exterior with exciters powered by amplifiers similar to those found on home stereo sets. Sensors then record the characteristics of the vibrations as they pass from one area of the vehicle to another.

Information from the tests allows engineers to verify the system design and mathematical models that predict how the Shuttle's control system will react to the much more severe vibrations expected during launch and flight into orbit.

The ground vibration tests will continue throughout most of the year with pauses only to change the test configuration of the Space Shuttle.



Positioned for Important Tests—Inside the dynamic test stand, the orbiter is lowered into position next to the Space Shuttle External Tank. The tank and orbiter were mated at the Marshall center and then "soft-mounted" inside the stand using a system with air bags and cables to suspend the vehicles from a large overhead truss. Ground vibration tests now underway involve these two Shuttle components in a simulated flight condition.

HEAO-1 Mission Deemed Successful

NASA's HEAO-1, the first in a series of unmanned observatories designed for the study of celestial X-rays and gamma rays, has been officially declared a success. Its primary objective was to obtain highly detailed experimental data on astrophysical phenomena by measuring the size and location of X-ray sources in the sky, and by determining the intensity and time variation of those sources.

That objective has been accomplished and, according to Dr. Noel W. Hinners, NASA Associate Administrator for Space Science: "X-ray sources barely visible in older studies stand out clearly in HEAO-1 data. The faintest sources are one million times weaker than the first X-ray star discovered 15 years ago.

"Many of the HEAO-1 sources are distant active galaxies. A map of the diffuse X-ray background shows that a hot thermal plasma extends beyond our galaxy and may spread throughout the universe. This is of major importance in understanding the early evolution of the universe."

HEAO-1, launched last August, carries four sets of experiments provided by the Naval Research Laboratory, Goddard Space Flight Center, Smithsonian Astrophysical Observatory, Massachusetts Institute of Technology, California Institute of Technology and the University of California at San Diego, all under contract to NASA. With few exceptions, the experiments returned excellent data during the six-month baseline mission operations program, which was completed last February.

(An extension of the HEAO-1 mission was recently authorized to permit a second scan of the celestial sphere and to broaden scientific participation through a guest investigator program.) HEAO-1 data will increase three or four times the known number of X-ray sources.

"In addition to the normal scanning maneuver, which is the primary operating mode of HEAO-1, the observatory points at specific celestial objects for detailed investigations," Dr. Hinners remarked. "To date, more than 80 of these pointings have occurred."

The secondary objective of the HEAO-1 mission was to demonstrate that the spacecraft was capable of supporting the experiments on board for six months. This objective also has been met. The spacecraft, designed and built by TRW, Inc., of Redondo Beach, Calif., has achieved or surpassed all design specifications. The initial activation of the spacecraft went exceptionally well and the performance since then has been excellent.

The rate gyro assembly, which was produced under a subcontract to Bendix Corp., and which encountered technical problems resulting in the initial HEAO launch delay, also has performed extremely well.

Drift rates, almost an order of magnitude below what were expected, have been experienced during the mission.

More information on new X-ray sources and their accurate locations is emerging as the analysis of HEAO-1 data proceeds. Dr. Hinners said: "Accurate location of X-ray sources has resulted in increased success in identifying the optical counterparts to the X-ray sources. This, in turn, will enable astrophysicists to study the radiation mechanisms in far greater detail than would be possible with X-ray data alone."

The second HEAO satellite, designed to study in detail interesting sources pinpointed by HEAO-1, is scheduled to be launched in November 1978. The third of the series will be launched in 1979.

The HEAO program is managed for NASA's Office of Space Science by the Marshall Space Flight Center.

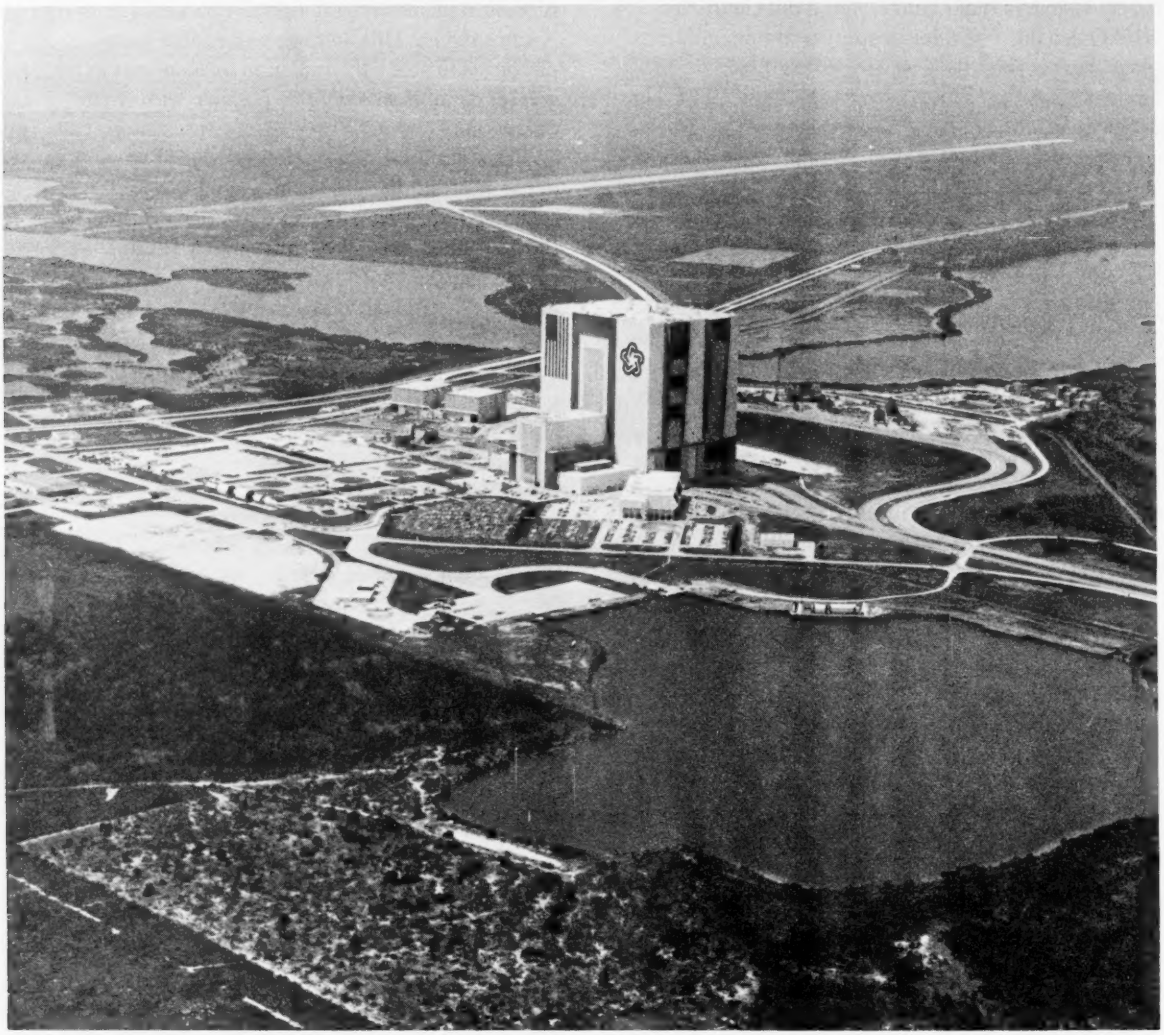
Fledgling Astronaut—Frederick D. Gregory, recently selected as an astronaut candidate, sits at the controls of NASA's terminal configured vehicle, at NASA's Langley center. The craft is designed to demonstrate and evaluate new concepts of airborne control systems for future use. Data produced are expected to be particularly applicable to the efficient operation of aircraft in high density terminal areas.

Big Facelift at Kennedy Center

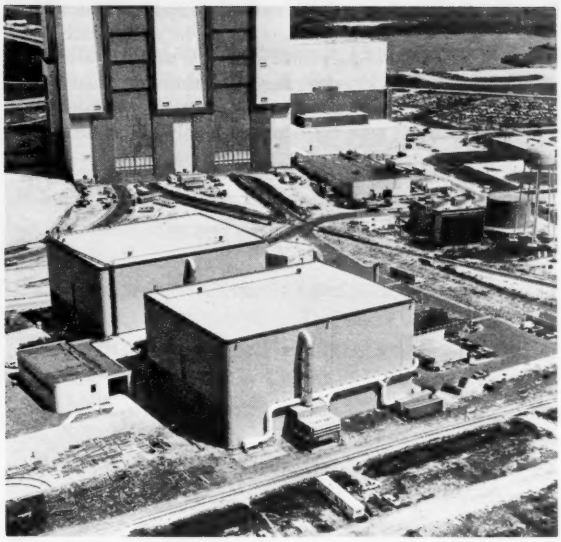
The changes, refurbishments and new construction going on at the Kennedy Space Center are many and varied as the center braces for a whole new era of space adventure following the arrival of the Space Shuttle next year. To accommodate the new and historic new responsibilities involved, almost all the established facilities are being modified by the directorates and contractors who must step lively to get the job done in time to meet a tight and complicated schedule.

The task facing the center is to build or modify buildings and apparatus; design, build and acquire equipment and ground support facilities; and then install, wire up and interconnect the thousands of complex systems involved and make everything work and be ready to lend support at the right time. Dr. Robert Gray, manager of the Space Shuttle Projects Office at KSC, is responsible for completion of the massive job.

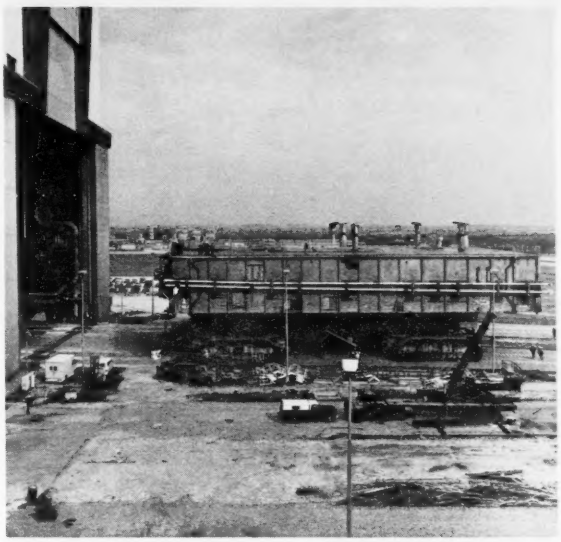
The accompanying pictures show only some of the activities underway in preparation for the first launch of the Shuttle, now scheduled for June 1979.



Long-range View—This picture shows most of the facilities that will provide both launch and return accommodations for the Space Shuttle missions, scheduled to begin next year. When ready for launch, the orbiter will travel from the Vehicle Assembly Building to its launch pad (beyond right margin of picture). Upon its return, the orbiter will land at the strip visible at top of photo, to be transported along the tow-way leading from the runway and seeming to end at the VAB.

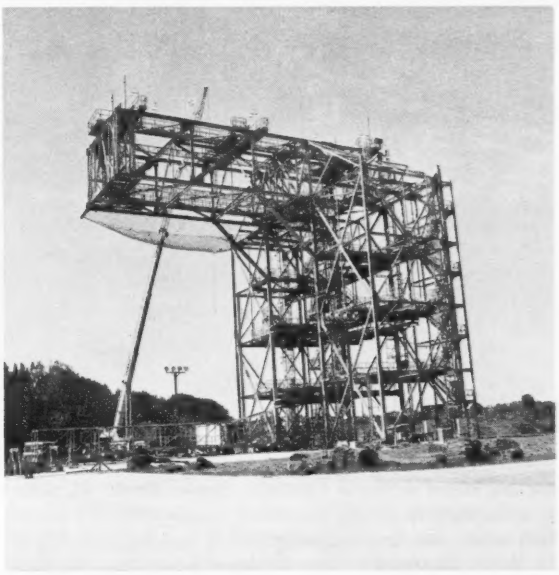


New Buildings for Handling Orbiter—Between missions, two orbiters can be processed simultaneously in this new tailor-made twin facility for orbiter processing. (Two orbiters are in various stages of production in addition to the number one *Enterprise.*)

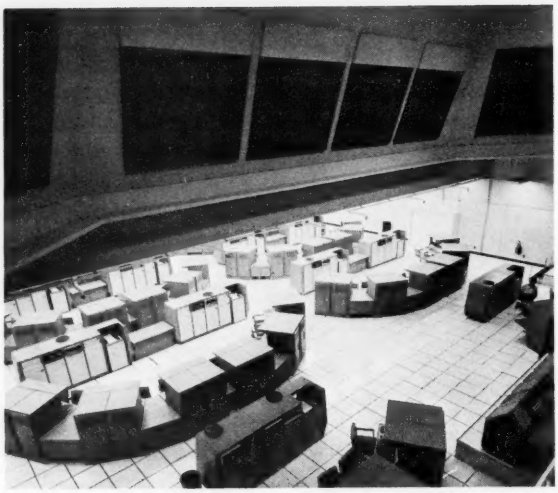


Immense Crawler Transporter—Massive loads will be carried on the top deck—the size of a baseball diamond—of this transporter. It will be used to move mobile launcher platforms with the assembled Space Shuttle between the VAB at the Kennedy center and the two launch pads at complex 39.

Imitation Orbiter—This 75-ton orbiter mock-up (same weight as the real thing) is used to check out training, testing procedures and equipment before the *Enterprise* arrives at the Kennedy center.



Heavyweight Lifter—This mate/demate device will raise and lower the orbiter from its 747 carrier aircraft. The open-truss device is 32 meters tall.



Back in the Limelight—Once again, in quarters that still seem to echo with exciting memories of the early space launches, a crowd of Space Shuttle experts will be seated at these consoles in 1979 when the first orbiter is blasted into space. The launch control center at the Kennedy center has been equipped with the new and highly automated launch processing system, designed especially for Space Shuttle checkout and launch.

Looking Down at Shuttle Facilities—Shown are the 87-meter tall water tank (1), which holds 1,025,500 liters of water, built to protect the orbiter and its delicate payloads from acoustical damage during launch; (2) the fixed service structure (lightning mast at top) with rotating service structure (3) nearby—to provide access to the orbiter for changeout and service of payloads at the launch pad; the liquid oxygen facility (4) which supplies one of the propellants (along with hydrogen) for the main engine; and the emergency egress system landing area (5), to be used in case of a mishap during launch procedures while the astronauts are in the orbiter. The system consists of a slide-wire running from the pad to the emergency landing site; should the need arise, the astronauts would move quickly into a small trolley-like device that would transport them to safety, traveling at high speed along the slidewire.

Inventors Honored

Thirty-three Langley Research Center inventors gathered at a recent luncheon to recognize the center's contribution to NASA's patent program during 1977.

Awards were presented by Dr. Donald P. Hearth, Langley director, and Dr. Howard J. Osborn, Langley patent counsel. Frederick J. Leès, chairman of the NASA Inventions and Contributions Board was the guest speaker.

Dr. Clarence D. Cone, Jr., was honored as the 1977 NASA Inventor of the Year. Dr. Cone, a former NASA cell and molecular biologist, is now with the Veterans Administration Center in Hampton, Va. His invention concerned a process for controlling cell division.

Others receiving awards were: Joseph G. Thibodaux, Jr., for a method of making a solid propellant rocket motor; Wayne S. Slemp, for a particulate and solar radiation stable coating for spacecraft; Dr. Judd R. Wilkins, for a method of detecting the presence of microorganisms; Harry V. Fuller, for a binocular device for displaying numerical information in a field of view; Vernon L. Alley and Austin D. McHatton, for an amplifying ribbon extensionmeter; Wilford E. Sivertson, Jr., for a method of locating people in distress; Daniel I. Sebacher and Alexander P. Sabol, for a solar hydrogen generator; Dr. Robert C. Costen, for a vortex generator for controlling the dispersion of effluents in a flowing liquid; Theodore R. Creel, Jr., and Robert A. Jones, for an apparatus for determining thermophysical properties of test specimens; Dr. Judd R. Wilkins and Stacey M. Mills, for an automated single-slide staining device; Mark R. Nichols, for a dual cycle aircraft turbine engine; Marvin D. Rhodes and Dr. Martin M. Mikulas, Jr., for a composite sandwich lattice structure; Oran W. Nicks, for an aircraft total energy sensor; Dr. Joseph S. Heyman, Jr., for a continuous wave ultrasonic bolt tensioning monitor; Ronald N. Jensen, for a solar heating system; Dr. Robert S. Rogowski and Dr. Edward R. Long, Jr., for a thermoluminescent aerosol analysis; Lloyd S. Keafer, Jr., Ernest E. Burcher and Leonard P. Kopia, for a transmitting and reflecting diffuser; Dr. Reginald J. Exton, for a TV fatigue crack monitoring system; David B. Rhodes, for an optical scanner; Renaldo V. Jenkins and Alexander P. Sabol, for a rotary engine; George M. Dudley, for a mono-page paper distributor; Donald J. Progar, Dr. Vernon L. Bell, Jr., and Dr. Terry L. St. Clair, for polyimide adhesives; and George E. Dickerson, for a composite lamination method.

Top Inventor—Dr. Clarence Cone, Jr. (left) and Alexander Sabol were two of many inventors honored at a recent Langley center ceremony. Cone (now with the Veterans Administration) was named NASA Inventor of the Year for 1977.

New Deputy Associate Administrator for Space and Terrestrial Applications

Samuel W. Keller recently was appointed Deputy Associate Administrator for Space and Terrestrial Applications (OSTA), a position previously held by Leonard Jaffe.

Keller is now responsible for the general management and direction of the OSTA programs under the direction of the Associate Administrator for OSTA.

In earlier years, Keller held various positions in industry and government, and served as a pilot in the U.S. Air Force from 1956 to 1959. Just before he joined NASA's Goddard Space Flight Center in 1960, he was a patent advisor with the Office of Naval Research. He held numerous management positions at Goddard until 1975 when he came to NASA headquarters as Assistant Administrator for Personnel Programs, a position he held until the NASA reorganization in late 1977. He received the NASA Exceptional Service Medal in 1969.

Keller received his degree in electrical engineering from the University of Maryland in 1955 and his law degree from George Washington University in 1962.

Large Award for Energy Saver

Thomas A. Blackstock recently received the first major award for an energy saving proposal at NASA's Langley Research Center when Langley director Donald P. Hearth presented him with a check for $1,245, the largest monetary suggestion award ever presented at the center.

Looking on (at left) is Dr. Gerald D. Walberg, head of the aerothermodynamics branch. Blackstock, of the space systems division, was recognized for his outstanding contribution toward upgrading the high-pressure air supply system for the continuous flow hypersonic tunnel. His suggestion enables the tunnel to use intermittent, short-duration flow blow-down test capability rather than operating in the longer-duration continuous flow mode. The energy savings during the first year after incorporating Blackstock's suggestion are estimated at $30,000. The savings were achieved without compromising the tunnel's research capability. Since wind tunnels consume over one-third of the electrical energy purchased at Langley, Blackstock's achievement is particularly significant.

Chapman Resigns

Kenneth R. Chapman, who became NASA's Associate Administrator for External Relations in January 1978, resigned June 3, 1978 to become vice president of market research and analysis at Vought Aircraft Co., Dallas, Texas.

Before joining NASA, Chapman was director of nuclear material safety and safeguards of the Nuclear Regulatory Commission. He is a retired Air Force major general.

First Fixed-Wing Flight for New Aircraft a Success

A new kind of research helicopter—equipped with rotors, wings and two jet engines—lifted off the runway recently at NASA's Wallops Flight Center in the first flight of the Rotor Systems Research Aircraft. The RSRA has a compound helicopter configuration which includes two auxiliary thrust engines and a 13.7-meter (45-foot) wing.

Powered by its two TF34 turbofan engines, the RSRA accelerated down the runway and climbed to an altitude of 610 m (2,000 ft.), using the combined lift of its wing and five-blade S-61 rotor system.

The compound RSRA was flown by experimental test pilots Charles Reine and Gerald Stofer of Sikorsky Aircraft, builders of the aircraft. On hand to witness the first flight were Oran Nicks, deputy director of NASA's Langley Research Center, and Leo Kingston, chief of advanced research and development for Sikorsky Aircraft.

Two RSRA vehicles were built by Sikorsky for a program jointly funded and managed by NASA and the U.S. Army. The program develops technology to increase rotor aircraft speed, performance, reliability and safety, and seeks to reduce helicopter noise, vibration and maintenance.

Both RSRA vehicles will be tested by Sikorsky, under contract to Langley center, for about 80 hours of flight time before they are delivered to NASA and the Army for flight research at the Ames center.

Sam White, NASA-Army project manager for the RSRA, said the aircraft "will provide the United States with a highly sophisticated and much needed research facility for continued development and understanding of rotary wing technology.

"The RSRA will help eliminate the costly practice of having to develop or extensively modify helicopter aircraft in order to conduct flight investigations for each promising new rotor concept. It is readily adaptable to accommodate new rotors and provide precise measurements of a variety of rotors under repeatable test conditions."

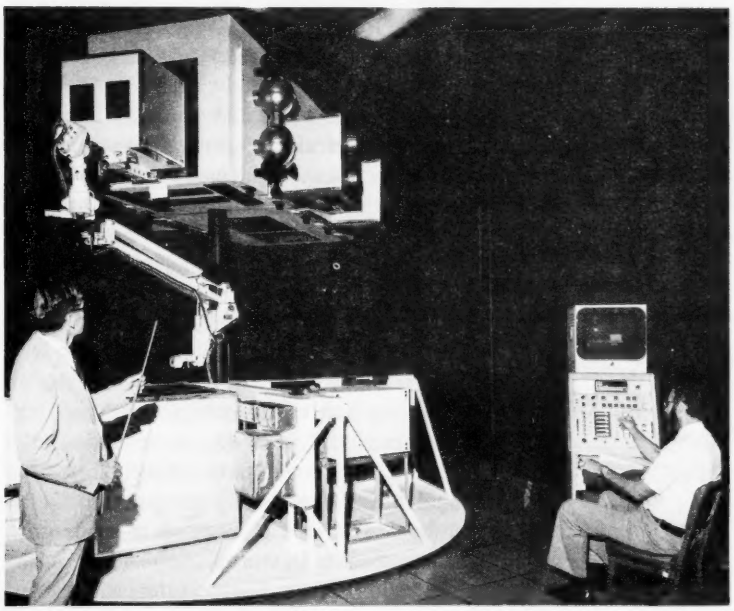
It will also make possible the testing of rotor systems in maneuvering flights at a wide range of altitudes and air-speeds, tests that cannot now be done in wind tunnels. RSRA will allow a better assessment of rotor performance because of its ability to isolate in-flight rotor characteristics from aircraft system characteristics, a procedure that cannot be accomplished on the ground or in other aircraft. Because it can be fitted with fixed wings, the RSRA can test

unproven rotor systems that normally would be too small to support the RSRA aircraft.

The craft also provides extra safety for its crew. Any rotor system can be pyrotechnically separated from the aircraft without jeopardizing the RSRA's ability to return safely to its base.

A second RSRA also is being tested at Wallops under the direction of the Langley center. It has a unique rotor vibration isolation system that prevents the transmission of main rotor vibrations to the fuselage structure, a feature that allows installation of different rotors on the RSRA without any fuselage modification.

Successful Flight of New Aircraft—A milestone flight of the joint NASA/Army Rotor Systems Research Aircraft (RSRA) was accomplished in April at Wallops Flight Center. Sikorsky Aircraft pilots successfully completed a 40-minute flight of RSRA for the first time in the full compound helicopter configuration with auxiliary thrust, TF34 engines and variable incidence wing.



Space Robot—On-orbit maintenance of future satellites might be performed by a robot-like device like this one being tested at the Marshall center. The robotic arm is shown removing a box that resembles a faulty module in a spacecraft such as the Space Shuttle. The arm will then store the malfunctioning module on the servicing platform and replace it with a new one carried aboard the platform. John Burch (left), Marshall center test supervisor for the device, watches the operation, as Don Scott operates a control panel that commands the arm's actions.

Langley Director Receives Honorary Doctorate

Donald P. Hearth, director of NASA's Langley Research Center, received the honorary degree of Doctor of Science during commencement exercises at George Washington University, Washington, D.C. in May.

Guest speaker at graduation ceremonies for the School of Engineering and Applied Science, Hearth discussed "Technology and the Future." Among other things, he said: "There will continue to be a strong tendency to characterize technology as either the savior of society's problems or the villain in the drama of life. Technology is not magic, but it can help solve some of society's problems."

Hearth's address included a short history of technology and projections of some of the possibilities and uses of technology in the near future. Citing the motion picture, "Star Wars," in an analogy about technology, he said "It's not just about good guys and bad guys, but about good technology and bad technology . . . We want a computer age with room for feelings. We want machines, but not the kind that run us. We want technology but we want to be in charge of it."

Hearth has directed the activities of the Langley center since September 1975. He is responsible for the center's aeronautical and space research programs, as well as its facilities, people and administration. He also serves as an advisor to the NASA Administrator.

He is the recipient of the NASA Exceptional Service Medal (1969), a NASA Executive Performance Award (1975) and NASA's highest honor, the Distinguished Service Award (1975).

A native of Fall River, Mass., Hearth earned a bachelor of science degree in mechanical engineering from Northeastern University, Boston in 1951. He did post-graduate work at the University of California, Los Angeles, and the University of Southern California from 1959 to 1961, studying rocket propulsion, hypersonic aerodynamics, heat transfer, electronics, and public administration. He attended the Federal Executive Institute in 1973.

Two Chemical Cloud Launches Carried Out

Two chemical vapor trails were ejected from rocket-launched payloads at dawn from NASA's Wallops Flight Center May 20 and 22. The pair of upper atmospheric experiments were launched by NASA for the Air Force Geophysics Laboratory (AFGL), Hanscom Air Force Base, Mass. aboard a two-stage Nike sounding rocket. Their objective was to measure the turbulent transport properties of the stratosphere by observing the evolution of chemical vapor trails deposited at an altitude of between 15 to 50 kilometers.

The vapor trails are composed of titanium dioxide particles released in spurts at 10-second intervals, forming a series of dashes similar to an aircraft contrail. The lower portions of these vapor trails are orange and the upper trail is white. The chemical vapor trail was visible to residents within a 128-km radius of the Wallops center. The vapor trail dispersions are recorded by camera sites on the ground.

Dr. A.F. Quesada is the AFGL project scientist and Richard H. Bradford is the Wallops center coordinator.

Medical Conference at Langley Covers Many Subjects

A four-day conference on safety, occupational medicine, and environmental health was held at NASA's Langley Research Center in May. About sixty representatives from all the NASA field centers attended.

The meeting opened with a welcome by Fred Bowen, Langley technical manager for management operations. Topics discussed included audiometric testing, types of hearing loss, rehabilitative techniques, noise protection equipment, and computerized treadmill data. Later Dr. Fred Kelly, Langley medical director, discussed the Langley nutrition program and then the group experienced the program firsthand with lunch in the cafeteria.

Donald P. Hearth, Langley director, opened the next day's meeting that included topics such as workmen's compensation, disability, continuation of pay status, and Langley's occupational medicine, environmental health, and safety programs.

The agenda also covered discussions of space suit testing, new approaches in workplace health standards, fire protection, Space Shuttle safety challenges,

the kinetic method of lifting, and system safety as applied to wind-turbine generators, as well as nuclear safety in space systems, Space Shuttle occupant safety, and new firefighting equipment.

Candidates in Competition for Spacelab Slots

Eight scientists—six American and two British—recently became candidates in the competition for two experimenters' seats aboard the second flight of Spacelab, the space laboratory to be flown in NASA's Space Shuttle in 1981. Experimenters (payload specialists) selected for these positions constitute a new breed of scientist who will be able to fly in space with his or her own equipment.

Four from the group will be selected to train in the operation of the mission's 13 scientific investigations. At a later date, two of the four will be chosen to fly on the 7-to-12 day mission. The other two will perform in support and advisory capacities at the Johnson Space Center.

Selections were made by the scientists whose experiments will be placed aboard Spacelab 2. These scientists, who represent 13 experiment teams from the United States and the United Kingdom, make up the investigators working group (IWG), which is charged by NASA with directing the scientific investigations on the mission. The United Kingdom is sponsoring two major experiments on Spacelab 2. The principal investigators for these experiments participate fully and equally in the IWG, and thus have proposed the participation of certain scientists as payload specialists.

Dr. E. W. (Gene) Urban, chief of the cryogenic physics branch of the space sciences laboratory at the Marshall Space Flight Center, is mission scientist for Spacelab 2 and is chairman of the IWG. The Marshall center is managing the first three Spacelabs for NASA, including the payload specialist training program.

Payload specialists, who are employed by the payload sponsoring agency, differ from NASA's permanent astronaut pilots and mission specialists in that they are selected and trained specifically for a particular mission. As a mission is carried out, the payload specialists make it possible for the responsible scientists to concentrate on executing their particular missions. The responsibility of flying and maintaining the Space Shuttle vehicle rests with the permanent astronaut crew.

Spacelab 2 is the second mission scheduled to use equipment being developed and built by the European Space Agency. Spacelab 2 will be carried into orbit inside the Space Shuttle orbiter launched from the Kennedy Space Center. Later missions may be launched from the Western Test Range in California.

Spacelab is designed to provide two basic components which can be arranged into several configurations. One component, the module, is a large pressurized container that allows the payload specialists to conduct their investigations in a "short sleeve" environment. The other component, called the pallet, is a structural platform which is exposed to the space environment and provides power, data, and thermal functions to the instruments mounted on the vehicle.

Spacelab 2 will feature no manned module. Most of its experiments will be exposed to space on pallets in the orbiter payload bay. Because of this, the payload specialists will operate the instruments from the orbiter crew cabin, working complementary shifts so the experimentation can continue for 24 hours a day.

The eight finalists, ages, schools attended and places of employment are:

- Loren W. Action, 42; University of Colorado; Lockheed Palo Alto Research Laboratory, Palo Alto, Calif.
- John-David F. Bartoe, 33; Georgetown University; Naval Research Laboratory, Washington, D.C.
- John W. Harvey, 37; University of Colorado; Kitt Peak National Observatory, Tucson, Ariz.
- Bruce E. Patchett, 30; Sussex University, U.K.; Appleton Laboratory, Astrophysics Research Division (Calham Laboratory), Abingdon, Oxon, U.K.
- N. Paul Patterson, 38; Yale University; Ball Brothers Research Corporation, Boulder, Colo.
- Dianne K. Prinz, 39; Johns Hopkins University; Naval Research Laboratory, Washington, D.C.
- George W. Simon, 43; California Institute of Technology; Sacramento Peak Observatory (Air Force Geophysics Laboratory), Sunspot, N.M.
- Keith T. Strong, 26; Advanced Studies in X-ray Space Science Laboratory, Dorking, U.K.

New International Affairs Officer

Dr. Edward M. Ifft recently was made chief of international programs policy at NASA headquarters.

Ifft is a U.S. Foreign Service reserve officer whose last assignment was as director of the State Department's office of disarmament and arms control.

Ifft, 40, grew up in Butler, Pa. He received a B.A. degree from Antioch College in 1960 and a Ph.D. in physics from Ohio State University in 1967. While a graduate student, Ifft spent a year at Moscow State University under the U.S.-USSR cultural exchanges program, during which he carried on research in low temperature physics and also traveled widely throughout the Soviet Union. He was an NSF Fellow while in graduate school at Ohio State. He is the author of several articles in scientific journals in both the U.S. and USSR.

Ifft began his government career in 1967 when he joined the U.S. Arms Control and Disarmament Agency. There, he worked primarily on the Strategic Arms Limitation Talks (SALT) with the USSR, spending a considerable period as a member of the U.S. delegation in Helsinki and Vienna.

In 1973, Ifft moved to the State Department, where he became deeply involved in the SALT II negotiations in Geneva. He also has worked extensively on the problem of constraints on nuclear testing. He was Deputy Chairman of the U.S. delegation which negotiated the Threshold Test Ban Treaty in Moscow in 1974 and he participated in negotiations toward a comprehensive test ban now underway with the UK and USSR.

Ames Scientist Wins Award for Best Scientific Paper

Knowledge of how cells get the energy to shuttle nutrients across their outer membranes has won for its discoverers a top NASA prize. Dr. Janos K. Lanyi of the extraterrestrial biology division at NASA's Ames Research Center and associate professor Dr. Russell E. MacDonald of Cornell University were awarded the 1978 H. Julian Allen Award in April. The award honors the author of the best scientific paper published by an Ames researcher.

The researchers experimented with primitive bacteria found in San Francisco Bay area salt flats, but the same cellular pumping mechanism they discovered are at work in human cells, according to rapidly accumulating evidence. The new knowledge is essential to understanding basic human biological activities such as nerve conduction and food assimilation, processes dependent on the efficient transport by membranes of molecules in and out of their cells.

Lanyi

Lanyi originally worked with *Halobacterium halobium,* a bacterium whose special pigment, bacteriorhodospin, contributes to the reddish color of San Francisco Bay area salt flats. Bacteria utilize the pigment in their membranes to turn sunlight into energy and food, in much the same way that green plants use chlorophyll.

The bacterium *H. halobium* is related to bacteria thought to have evolved early in the history of life on Earth. Thus Lanyi's discoveries may represent a model of how bacteria first used light energy to acquire molecules from the environment it could not create. MacDonald then showed similar sodium ion gradients at work in other bacteria, including some common in man.

In recognition of his research, Lanyi was awarded the NASA Medal for Exceptional Scientific Achievement in December 1977. His work at Ames' Extraterrestrial Biology Division is part of studies of Earth organisms that live in extreme environments, such as those that might be found on other planets.

NASA's Educational Chief Gets Award

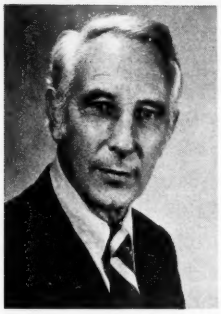
Dr. Fred Tuttle, chief of NASA's educational services branch in the public affairs division and director of NASA's educational programs since 1970, was honored by the Council of State Science Supervisors at its recent annual convention when he was made an honorary member of the Council.

Each year the Council selects for this prestigious award one or two educators "who have demonstrated the highest ideals of service to science education."

Along with Tuttle, the Council this year selected Frank D. Kizer of Virginia, its founder in 1962, and its executive secretary for 16 years.

Tuttle, a native of New Haven, was educated in local schools and at Yale University where he earned his B.A. and Ph.D. For 16 years, except for 20 months in the Marine Corps, he served in New Haven public schools as teacher of English and coach of track at Hillhouse. He was principal of Eaton and then of Winchester School. Following service in New Haven his career included the school superintendency at Westerly, R.I., and the graduate studies deanship at the State University of New York's College at Plattsburgh.

Jones Award Goes to Langley Engineer



Edwin C. Kilgore, director for management operations at NASA's Langley Research Center, has been selected as a recipient of the first Roger W. Jones Award for Executive Leadership, 1978. Sponsored by the American University, the Jones Award recognizes federal career executives who have demonstrated superior leadership resulting in outstanding organizational achievement. They also must have been successful in developing managers and executives for career service.

Kilgore was nominated for this award by NASA Administrator Robert A. Frosch. He received a bronze statue and citation by Roger Jones and university officials on May 13 at the American University Honors Convocation in Washington, D.C.

At Langley, Kilgore has been responsible for center activities in personnel, financial management, procurement, management support, business data systems, scientific and technical information, occupational health services and technology utilization since 1975.

From 1970 to 1975, he served in several managerial positions at NASA headquarters, including that of Deputy Associate Administrator (Management) and Acting Associate Administrator in the Office of Aeronautics and Space Technology. In 1974, he was appointed Deputy Associate Administrator for Center Operations, a management office responsible for all NASA field center operations.

Kilgore is a graduate of Virginia Polytechnic Institute and State University, where he received a B.S. degree in mechanical engineering in 1944. On graduation, he joined the NASA staff.

Did You Know?

On April 27, 1909, the first official test flight of the Army's first airplane took place. It was made by Orville Wright and Lt. Frank P. Lahn. The first Navy Wright airplane was delivered on July 19, 1911, at Annapolis by Orville Wright.

Since 1957, 14 nations have sent more than 10,500 objects into orbit. To date, more than 6,000 have decayed—begun drifting to Earth. Most have burned up when they reentered the atmosphere, but some parts have survived. To date, however, there have been no confirmed instances of serious damage or death from space debris.

The Japanese explorer, Naomi Uemura, 37, who undertook a trip alone by dogsled to the North Pole (reported as being tracked by the Nimbus 6 satellite in *Activities* of April 1978), reached his destination on April 30. He thus became the first person to have survived a grueling 54-day journey across 600 miles of frozen Arctic Ocean. Others have made it to the North Pole, but never alone. One of the dangers Uemura faced was the ransacking of supplies by a polar bear. The sneak thief was shot to death when it returned the next day looking for additional loot. Uemura's expedition was sponsored by the National Geographic Society.

In Peking, China, an eight-year space development plan was announced which represents a major effort for that country to catch up with the United States and the USSR in space exploration, lasers, computers and other fields of technology. In presenting the plan, China's Vice Premier Fang Yi acknowledged that his country is 15 to 30 years behind in many fields of science and technology.

Improved materials for aircraft tires will continue to be the subject of NASA investigations during FY 1979. Emphasis will be on elastomers that promise improved wear and blowout resistance. Some polymer blends have shown about three percent improvement in wear over state-of-the-art aircraft tire tread materials. NASA also will explore holographic techniques for non-destructive flaw detection in aircraft tires.

Contractor News

Pratt & Whitney Aircraft Group of United Technologies Corp., East Hartford, Conn., has been awarded a NASA contract for $80.4 million to develop advanced technology. The effort concentrates on technology expected to improve significantly the fuel efficiency of future turbofan engines for commercial airline use. Options could raise the total value to $94.4 million. The engine technology effort is the major part of the energy efficient engine project, an element of NASA's aircraft energy efficiency program.

McDonnell Douglas Astronautics Corp. of Huntington Beach, Calif. has won a letter contract from NASA for the fabrication and subassembly of components for four 3900 series Delta space vehicles. Estimated cost of this add-on is about $12 million, bringing the total contract value to $540 million. Subassembly is to be completed in late 1979.

McGregor & Werner, Inc., of Washington, D.C., has been selected by NASA's Kennedy center for award of a contract for printing, reproduction and documentation support services. The cost-plus-award-fee contract extends from June 30, 1978 to June 30, 1979 and has a first year value of $3.2 million. The contract is one set aside for small business concerns.

Contracts totalling $2.8 million have been awarded to five educational institutions by NASA's Marshall center for scientific investigations in support of the Space Telescope project. Marshall is NASA's lead center for the project and is responsible for the system; the Goddard center is responsible for the scientific instruments and planning telescope operations. The contracts are: Research Foundation of the State University of New York at Albany, $126,000; Beloit College, Beloit, Wis., $69,000; Institute for Advanced Study, Princeton, N.J., $257,700; Johns Hopkins University, Baltimore, Md. $151,300; University of Texas at Austin, $1,862,500; University of Texas at Austin, $285,400. All the scientists involved at the various institutions are members of the Space Telescope science working group, formed to provide scientific guidance to the project. Chairman is Dr. C. R. O'Dell, associate director for science at the Marshall center and project scientist for Space Telescope.

IBM Corp. has received an extension of its contract with NASA's Johnson center for equipment, materials, facilities and people for software for the center's ground-based computer and training systems. The $50 million supplement extends the contract through March 1980 and brings the total value to $83 million.

The Beldo Steel Corp. of Orlando, Fla., has received a $1.3 million contract from NASA's Kennedy center for construction of a canister to carry payloads from checkout facilities for installation in the Space Shuttle orbiter.

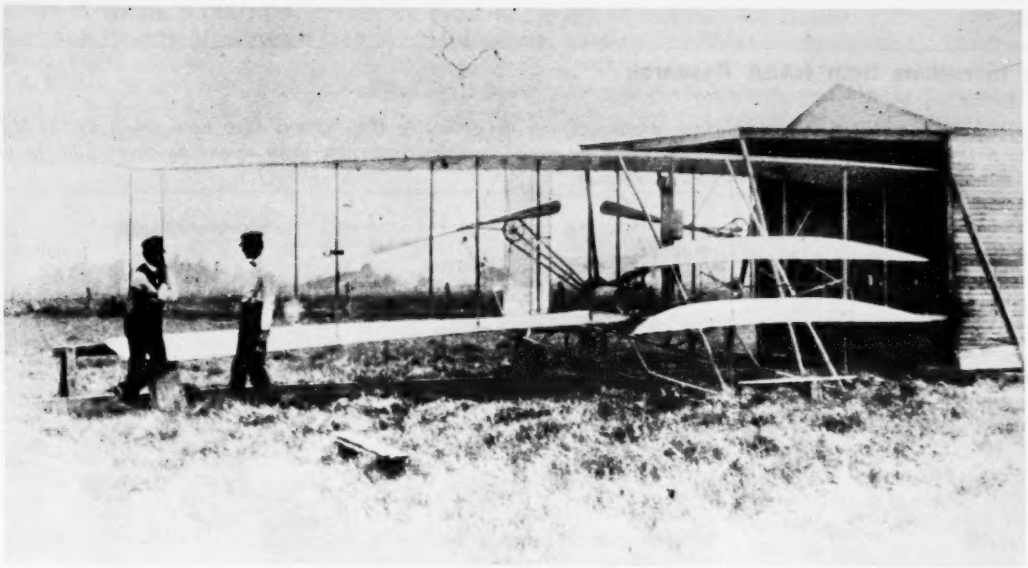
Boeing Services International, Inc., of Seattle has been selected by NASA for negotiations leading to the award of a contract for supply and transportation services in support of programs at the Kennedy center, NASA's primary launch and landing site for Space Shuttle flights to begin in 1979. Total estimated cost and maximum award fee for the first three years of operation is about $19 million.

Rockwell International Space Division has received a contract from NASA's Johnson center for the Space Shuttle orbiter covering anticipated cost adjustments and increases. The $125 million adjustment brings the total Rockwell contract value to about $3.46 billion.

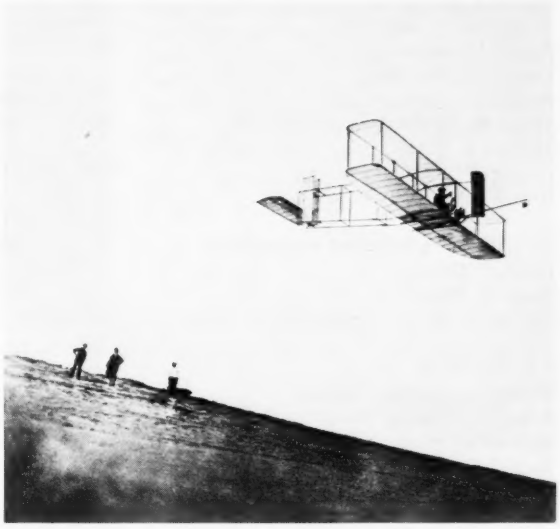
Citrus Mechanical, Inc., of Inverness, Fla., won a $67,555 contract from NASA's Kennedy center to install solar heat collectors, heat exchangers and a control system for the provision of hot water for use in the center's cafeteria in the headquarters building. Solar energy is already in use at the KSC visitors center cafeteria.

The Rocketdyne Division of Rockwell International Corp. of Canoga Park, Calif., will provide nine additional Space Shuttle main engines to NASA under terms of a letter amendment to the firm's present contract for seven such engines. The amendment authorizes Rocketdyne to proceed with manufacture and testing of the nine engines during a 180-day period in which price negotiations will be conducted, at an estimated price of $250 million. The Marshall center is responsible for design and development of the main engines.

The A-V Service Corp. has been selected by NASA to enter into formal negotiations for award of a contract for audiovisual public information support services. Work will fall into two main areas—general audio-visual support and motion-picture production. The proposed cost of the one-year contract is about $600,000.



Pioneering Aircraft—Orville and Wilbur Wright are being honored in ceremonies and exhibits all over the country this year, the 75th anniversary of powered flight. In the left photo, the Wright brothers are shown at Huffman Prairie, Ohio, with one of their earliest models of a glider (1904 or 1905); the photo at right shows a later, more sophisticated model, flying at Kitty Hawk, N.C. in 1911.



Galileo Memorial Scholarship Winners—Top 1978 winner Ri-Jen Chou a senior at the Homestead High School in Cupertino, Calif., receives his $750 Galileo Memorial Scholarship from Ames center director C. A. Syvertson. Recipients of $100 Savings Bonds for qualifying as finalists are: Paul Freiberg, Cubberley Senior High School, Palo Alto; Judy Jenvey, Mountain View High School; Sharon Seyman, Willow Glen High School at San Jose; Steven Snider, Aragon High School, San Mateo; and Bradley Teague, Bellarmine College preparatory school, San Jose. The awards and certificates were presented at the annual meeting of the San Francisco section of the American Institute of Aeronautics and Astronautics.

Patents for Inventions from NASA Research

The Office of General Counsel, NASA Headquarters, announces that the following U.S. patents have been issued by the U.S. Patent Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel of the indicated installation.

Inventor(s) and Employer	Title	Patent No.	Installation
Ernest E. Burcher, NASA/LARC Stephen J. Katzberg	Optical profilometer	4,088,408	LARC
Roger L. Shannon/Seattle, Wash. Roger B. Gillette/Auburn, Wash.	Plasma cleaning device	4,088,926	MSFC
James W. Blue/LERC	Improved targets for producing high purity 123 I	4,088,532	LERC
Lester J. Owens, NASA/KSC	Ocean thermal plant	4,087,975	KSC
William J. Debnam, Jr./LARC Carl L. Fales, Jr. Roger A. Breckenridge Arthur V. Pohm/Iowa State Univ.	Magnetometer with a miniature transducer and automatic scanning	4,088,954	LARC
Larry D. Holley/KSC Jerry W. Mason/Federal Electric Co.	Microcomputerized electric field meter diagnostic and calibration system	4,088,951	KSC
Willard W. Anderson/LARC Nelson J. Groom	Magnetic suspension and pointing system	4,088,018	LARC
Wayne H. Howard/ARC	Tread drum for animals	4,088,094	ARC
Robert W. Delaplaine/ARC Daniel L. Mossolani	Rotary leveling base platform	4,088,291	ARC
Donald L. Maiden/LARC	Two dimensional wedge/translating shroud nozzle	4,088,270	LARC
James B. Laudenslager/NASA, JPL Thomas J. Pacala	Charge transfer reaction laser with preionization means	4,088,965	NPO
Donald E. Barthlome/LARC	Collapsible corrugated horn antenna	4,089,004	LARC
Richard M. Dickinson/JPL	RF beam center location method and apparatus for power transmission system	4,088,999	NPO
Paul P. Zebus/Rockwell International Cyrus C. Haynie Poley N. Packer	Variable contour screening system	4,088,312	MSC
Charles G. Miller, NASA/JPL James B. Stephens	Solar pond	4,091,088	NPO
Paris H. Wiley, Virginia Polytechnic Institute	Logarithmic circuit with wide dynamic range	4,091,329	GSC
Richard N. Young, NASA/LARC	Independent power generator	4,091,613	LARC
M. Kudret Selcuk, NASA/JPL	A non-tracking solar energy collector system	4,091,798	NPO
Ronald M. Kubacki, Bell & Howell Chicago, Ill.	Boron trifluoride coatings for thermoplastic materials	4,091,166	ARC
David C. Grana, NASA/LARC David P. Haynes	Remote water monitoring system	4,089,209	LARC
Norman S. Cohen, NASA/JPL Leon D. Strand	Nitramine	4,092,188	NPO
Henry S. Dresser, Rockwell International, Downey, Calif. Joseph J. Daileda	Multi-purpose wind tunnel reaction	4,091,665	MSFC
Irwin Rubin, NASA Headquarters	Hexagon solar power panel	4,089,705	NHQ
Bruce W. Webbon, NASA/ARC	Spacesuit torso closure	4,091,465	
Carl R. Ryan. Motorola, Inc. Scottsdale, Ariz.	Quadraphase	4,092,606	GSFC
Hubert C. Vykukal, NASA/ARC	Spacesuit mobility joints	4,091,454	ARC
Edward S. Harrison, WRD Div., Chadwick B. Delano, Whittaker Corp. Salvatore R. Riccitiello, ARC	Polymeric foams from cross linkable poly-n-arylenebenzimidazoles	4,092,274	ARC
William T. Harrigill, Jr., NASA/LRC	A regulated high efficiency lightweight capacitor-diode multplier DC to DC converter	4,092,712	LERC

Robert H. Hartop, NASA/NPO	Reflex feed system for dual frequency antenna	4,092,648	NPO
Kazimiera Paciorek, Ultrasystems, Inc. Irvine, Calif.	Heat resistant polymers of oxidized styrylphosphine	4,092,466	MSFC
Leo E. Titus/Hughes Aircraft Co.	Wide power range microwave feedback controller	4,092,617	GSFC
John T. Polhemus, NASA/JSC Joseph E. Morgan Arthur Mandell	A condition sensor system and method	4,092,633	JSC

NASA Team Earns Presidential Acclaim— President Jimmy Carter presented Curtis R. Helms (second man to the President's left, holding plaque) and Thomas W. Winstead (standing second to the President's right, wearing glasses), both of the Marshall center's structures and propulsion laboratory, with two of seven 1977 Presidential Management Improvement Awards. The ceremony, attended by numerous government officials and NASA representatives, took place in the Rose Garden at the White House on May 23. According to their citations, Helms and Winstead (selected from a field of 50 outstanding candidates) were honored for their exceptional contribution to redesigning the Space Shuttle external fuel tank, eliminating one of the two vent-relief valves and reducing vehicle weight and program costs while still meeting venting requirement and reliability standards. Their contribution produced total savings of $5.6 million. The Marshall team is one of 66 individuals and groups that have earned the high honor since the award program was established in 1970.

(continued from page 28)

Ovation researchers considered the ideal shape for full, rich and constant tones throughout the instrument's range. Wood, traditionally used, did not lend itself to the new design so the Ovation team again delved into aerospace research and eventually produced guitars made from strong, lightweight materials used in aircraft and helicopter construction.

For manufacturing the guitars, Ovation again borrowed from aerospace technology to develop special jigs and fixtures. This assured effective quality and cost control in the manufacturing process and reduced the labor requirements; although considerable hand work is still necessary, company officials estimate that man-hours needed to produce an Ovation guitar equal about one-fifth of those required to produce competitive instruments of similar quality.

The Ovation story is an excellent example of spinoff advantages of space research because it illustrates a number of points with regard to technology re-use. It shows, for instance, the universality of spinoff, its reach into virtually every avenue of everyday existence. Frequently, as in the case here, the secondary application is surprisingly remote from the original technology.

Most importantly, the Ovation case underlines the economic potential of spinoff. As happens frequently, a whole new company was formed to manufacture and sell a spinoff product, with eminently successful results that contribute to the Gross National Product and to the creation of jobs.

Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

A Cultural Advance in Music

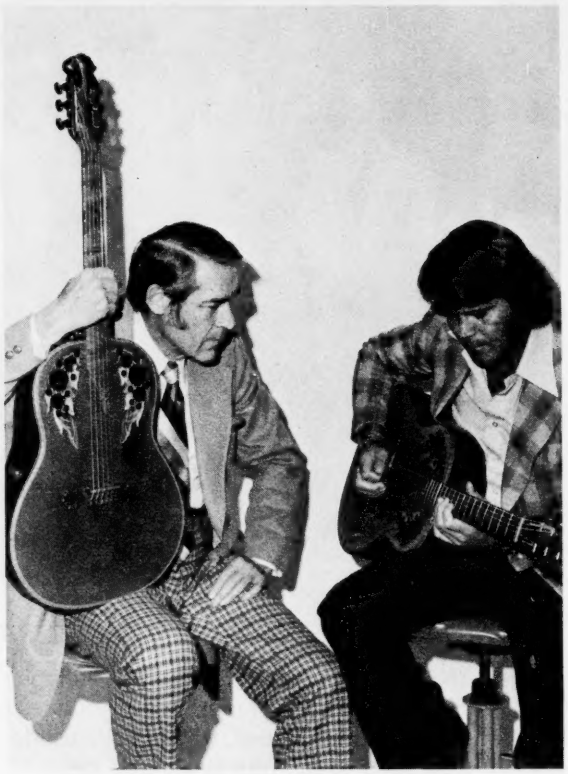
The guitar, one of the world's oldest stringed instruments, hardly seems to have a natural affiliation with aerospace technology. But a definite connection has been established in the past few years.

A whole family of high-quality guitars has been an outgrowth of helicopter rotor research conducted for NASA and the military services. The result has been the establishment of a multimillion-dollar-a-year business devoted to the manufacture of a type of guitar that, in quality and performance, has proven to be competitive with other high-quality instruments.

The discoveries involved were coincidental to quite another investigation—of vibration in rotor systems by the Kaman Corp., a diversified company formed to develop and build helicopters. The technology thus developed (to "dampen" or reduce vibration) together with the availability of staff experts in vibration engineering, sparked an idea in the mind of the company president and founder, Charles H. Kaman. An experienced guitarist, Kaman reasoned that vibration-dampening technology could be turned around to *enhance* vibration and thereby produce a guitar with superior sound. He researched the guitar field and found that, although the instrument has been popular since the 16th century, little was known about its physics with respect to complex vibrations and their influence on sound. Kaman put the quest for sound excellence on a scientific basis, using special vibration analysis equipment patterned on aerospace technology. What began as a basement hobby project grew to the point where a subsidiary company, Ovation Instruments, was formed to manufacture and sell the guitars.

From two years of vibration analysis emerged an innovative bowl-like guitar design that

(Continued on page 27.)



Superstar Guitar—Charles H. Kaman, president of Ovation Instruments, Inc., watches singing star Glen Campbell as he plays the company's top-of-the-line guitar, the newly created "Adamas" (Latin for "diamond in the native form of carbon"). The Adamas incorporates carbon fibers with wood in a "sandwich" construction of the guitar's soundboard. Rare woods and a special finish are combined to produce a handsome product. The Adamas is a superior instrument with great response over the entire playing range, startling clarity, a response rate within three decibels over the entire playing spectrum, and a fundamental frequency near 90 cycles per second.

NASA
National Aeronautics and Space Administration